There's always a solution in steel.

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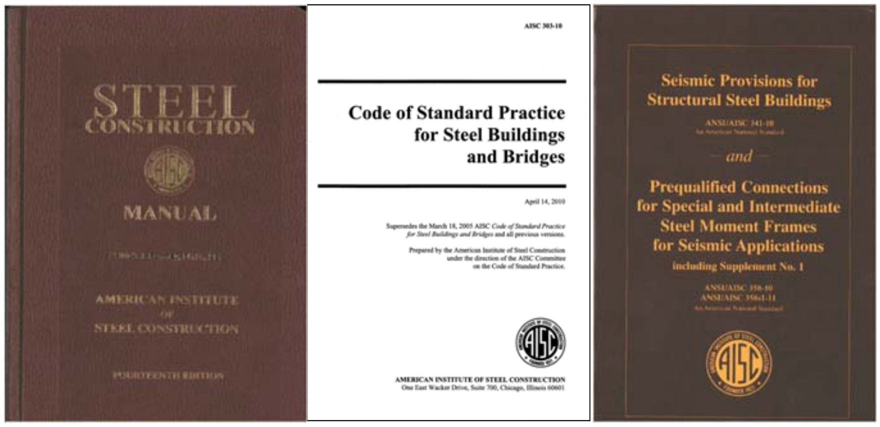
There's always a solution in steel.

Effective Communication of Connection Design

Presented by
Patrick J. Fortney, Ph.D., P.E., P.Eng.
Cives Engineering Corporation
Cives Steel Company

structural STEEL

Effective Communication of Connection Design



Patrick J. Fortney, Ph.D., P.E.
Manager of Engineering and Chief Engineer
Cives Engineering Corporation
Cives Steel Company

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Objective

It is common practice in the steel construction industry for SEoRs to designate structural steel connection design to the fabricator's engineer

6

Objective

It is common practice in the steel construction industry for SEoRs to designate structural steel connection design to the fabricator's engineer

This type of arrangement requires effective communication between the SEoR and the fabricator

7

Objective

It is common practice in the steel construction industry for SEoRs to designate structural steel connection design to the fabricator's engineer

This type of arrangement requires effective communication between the SEoR and the fabricator

The objective of this discussion is to illuminate the type of information that needs to be communicated, and effective ways of doing so

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Previous Practice Finally in Writing

Although the practice of fabricators designing connections has been common for decades, AISC Code of Standard Practice (COSP) has not explicitly recognized this practice…until now

9

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AISC 303-10 (COSP) explicitly recognizes this practice

http://www.aisc.org/epubs

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Objective

Why is communication of design criteria and expectations so critical?

11

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When the fabricator's engineer is given any portion of design scope, this needs to be clearly indicated on the design documents.

12

Objective

Why is communication of design criteria and expectations so critical?

When the fabricator's engineer is given any portion of design scope, this needs to be clearly indicated on the design documents.

Misleading, false, omitted, and or/contradictory information leads to delays, errors, and ultimately unnecessary costs (sometimes significant).

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Objective

Why is communication of design criteria and expectations so critical?

When the fabricator's engineer is given any portion of design scope, this needs to be clearly indicated on the design documents.

If the Fabricator's engineer is required to sign and seal design calculations, this needs to be clearly indicated on the design drawings

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When the fabricator is given design scope, the company's risk profile is increased; requiring the fabricator to sign and seal design documents further increases the fabricator's risk profile

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When the fabricator is given design scope, the company's risk profile is increased; requiring the fabricator to sign and seal design documents further increases the fabricator's risk profile

With increased risk comes increased costs;
Estimators need to capture these costs

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Objective

Why is the coordination of information on design documents so critical?

Contradictory, incorrect, or omitted information can lead to inaccurate estimates during the bid stage

17

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Often times, requests for clarifications are not fully addressed prior to bid submittal

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Clarifications not fully addressed during the estimating stage have potential for change orders after award of project

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Often times, requests for clarifications are not fully addressed prior to bid submittal

Clarifications not fully addressed during the estimating stage have potential for change orders after award of project

Comprehensive coordination of accurate information provided on the design drawings minimizes the need for clarifications…

20

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Often times, requests for clarifications are not fully addressed prior to bid submittal

Clarifications not fully addressed during the estimating stage have potential for change orders after award of project

Comprehensive coordination of accurate information provided on the design drawings minimize the need for clarifications…

…which in turn minimizes the potential for change orders

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Objective

Why is communication of design loads so critical?

22

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When connections are completely designed by the SEoR, any trips in the project's design rules can be easily revised in-house to resolve issues related to a particular connection design

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When connections are completely designed by the SEoR, any trips in the project's design rules can be easily revised in-house to resolve issues related to a particular connections design

When the SEoR places connection design in the fabricator's scope, the trips encountered in the design rules become problematic for the fabricator in regard to decision making

24

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Why is communication of design loads so critical?

When connections are completely designed by the SEoR, any trips in the project's design rules can be easily revised in-house to resolve issues related to a particular connections design

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A connection designer stuck with impractical design rules causes unanticipated costs

25

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Why is communication of design loads so critical?

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When the SEoR places connection design in the fabricator's scope, the trips encountered in the design rules become problematic for the fabricator in regard to decision making

A connection designer stuck with impractical design rules causes unanticipated costs

In specific cases, impractical design rules include UDL

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Objective

Why is communication of design loads so critical?

There are unanticipated costs associated with impractical design rules

27

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Why is communication of design loads so critical?

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Unanticipated costs cannot be captured by an estimator at the bidding stage

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Objective

Why is communication of design loads so critical?

There are unanticipated costs associated with impractical design rules

Unanticipated costs cannot be captured by an estimator at the bidding stage

Effective, clear, and concise communication of design rules and design loads minimize these unanticipated costs

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General Topics for Discussion

First, we'll take a look at AISC 303-10 in regard to

1. The SEoR's options when designating connection design
2. Information the COSP requires the SEoR to provide on design drawings and in project specifications (in regard to connection design)

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General Topics for Discussion

First, we'll take a look at AISC 303-10 in regard to

1. The SEoR's options when designating connection design
2. Information the COSP requires the SEoR to provide on design drawings and in project specifications (in regard to connection design)

Then, we'll discuss the:

1. The information a connection designer needs from the SEoR, and
2. The information the SEoR needs from the connection designer

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General Topics for Discussion

Throughout the discussion, examples of effective communication and not-so-effective communication will be presented

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General Topics for Discussion

Throughout the discussion, examples of effective communication and not-so-effective communication will be presented

Many of the examples are taken from "real" projects. If you recognize a figure or find yourself intimately familiar with a particular example, please recognize that **discretion has been taken very seriously in the preparation of this presentation**

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Who's Designing the Connections?

The AISC *Code of Standard Practice* lists three options for the design of the connections.

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Who's Designing the Connections?

The AISC *Code of Standard Practice* lists three options for the design of the connections.

AISC 303-10 Section 3.1.2
The *owner's designated representative for design* shall indicate one of the following options for ***each connection***:

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Who's Designing the Connections?

The AISC *Code of Standard Practice* lists three options for the design of the connections.

AISC 303-10 Section 3.1.2
The *owner's designated representative for design* shall indicate one of the following options for ***each connection***:

I have taken the liberty of boldly underlining ***each connection***: as we proceed through the discussion, I'll refer back to this as I believe it is noteworthy to recognize this language

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Who's Designing the Connections?

Option	Description*	Designer	Responsibility
1	*The complete connection design shall be shown in the structural design drawings*	SEoR	SEoR
2	In the structural design drawings or specifications, the connection design shall be designated to be selected or completed by an *experienced steel detailer*	SEoR	SEoR
3	In the structural design drawings or specifications, the connection design shall be designated to be designed by a *licensed professional engineer working for the fabricator*	Fabricator's licensed professional engineer	SEoR and Fabricator's PE ???

*Section 3.1.2 of AISC 303-10, Code of Standard Practice

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OPTION 3 – The Fabricator's P.E.

In the structural design drawings or specifications, the connection design shall be designated to be designed by a *licensed professional engineer working for the fabricator.*

There are two common forms practiced under this option.

1. '…connection designs are supervised by a licensed professional engineer…'
2. '…connection designs are supervised by a licensed professional engineer, and all calculations are required to be <u>signed and sealed by licensed professional engineer</u>…

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OPTION 3 – Specifying the Fabricator's Scope

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OPTION 3 – Specifying the Fabricator's Scope

C. CONNECTIONS

1. ALL CONNECTIONS, EXCEPT FOR THOSE CONNECTIONS COMPLETELY DESIGNED ON THE DRAWINGS, SHALL BE DESIGNED AND DETAILED BY THE FABRICATOR. DETAILING SHALL BE PERFORMED USING RATIONAL ENGINEERING DESIGN AND STANDARD PRACTICE IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS. THE GENERAL DETAILS SHOWN ON THE DRAWINGS ARE CONCEPTUAL ONLY AND DO NOT INDICATE THE REQUIRED NUMBER OF BOLTS OR WELD SIZES, UNLESS SPECIFICALLY NOTED. THE CONTRACTOR SHALL SUBMIT ENGINEERING CALCULATIONS AND CONNECTION DETAIL DRAWINGS FOR EACH CONNECTION TYPE, MEMBER SIZE, AND REACTION INDICATED ON THE DRAWINGS FOR REVIEW BY THE ARCHITECT PRIOR TO THE SUBMITTAL OF THE STRUCTURAL STEEL SHOP DRAWINGS. AFTER REVIEW BY THE ARCHITECT, THESE DETAIL DRAWINGS SHALL BE UTILIZED AS THE STANDARD FOR FABRICATION AND SHOP DRAWING DETAILING. THE DESIGN CALCULATIONS SHALL BE PREPARED AND SEALED BY A QUALIFIED PROFESIONAL ENGINEER LICENSED IN THE STATE OF

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OPTION 3 – Specifying the Fabricator's Scope

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Indicate locations and dimensions of protected zones.
6. Identify demand critical welds.
7. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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7. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

Note that this does not require signing and sealing of shop drawings…

…If you want shop drawings signed and sealed, be clear!

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OPTION 3 – Specifying the Fabricator's Scope

(7) SUBMIT CHECKED SHOP DRAWINGS PREPARED BY A LICENSED PROFESSIONAL ENGINEER FOR APPROVAL. PRIOR TO SUBMITTAL OF DETAILED SHOP DRAWINGS,PROVIDE A SET OF JOB STANDARDS SHOWING ALL NECESSARY JOINT DETAILS. AFTER APPROVAL OF THESE STANDARDS,SUBMIT ERECTION PLANS INDICATING LOCATION OF JOINT AND MEMBER MARKINGS.

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9. SHOP AND ERECTION DRAWINGS SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER FOR REVIEW AND APPROVAL. NO FABRICATION OF STEEL SHALL COMMENCE WITHOUT APPROVED SHOP DRAWINGS.

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…neither require calculations or shop drawings to be signed or sealed.

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OPTION 3 – Specifying the Fabricator's Scope

2. All connections shall be designed by and all drawings shall be prepared under supervision of a Professional Engineer licensed in [redacted]. Do not submit unchecked shop drawings. First submissions of all job standards, shop drawings of connections not shown on, or that are in deviation of, the job standards, and calculations shall have one set sealed and signed by the Engineer. After final approval of all shop drawings, submit a final set sealed and signed by the Professional Engineer.

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OPTION 3 – Specifying the Fabricator's Scope

2. All connections shall be designed by and all drawings shall be prepared under supervision of a Professional Engineer licensed in [redacted]. Do not submit unchecked shop drawings. First submissions of all job standards, shop drawings of connections not shown on, or that are in deviation of, the job standards, and calculations shall have one set sealed and signed by the Engineer. After final approval of all shop drawings, submit a final set sealed and signed by the Professional Engineer.

With this note, the SEoR has designated connection design to the fabricator…

…both design calculations and shop drawings must be signed and sealed by the fabricator's licensed engineer.

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OPTION 3 – Specifying the Fabricator's Scope

Advice when selecting Option 3:

In project specifications and with notes on design drawings

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OPTION 3 – Specification

Advice when selecting Option 3:

In project specifications and with notes on design drawings

1) Clearly state that you are or are not designating the fabricator's engineer as the connection designer

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OPTION 3 – Specification

Advice when selecting Option 3:

In project specifications and with notes on design drawings

1) Clearly state that you are or are not designating the fabricator's engineer as the connection designer

2) Clearly state whether or not you require the fabricator's engineer to sign and seal design calculations

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OPTION 3 – Specification

Advice when selecting Option 3:

In project specifications and with notes on design drawings

1) Clearly state that you are or are not designating the fabricator's engineer as the connection designer

2) Clearly state whether or not you require the fabricator's engineer to sign and seal design calculations

   a) Common practice is to submit sample design calculations for each type of connection. If for some reason you require calculations for every connection, clearly state this (I am in no way promoting this type of requirement)

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Advice when selecting Option 3:

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3) Clearly state whether or not you require the fabricator's engineer to sign and seal shop drawings
4) Clearly identify which connections are in the fabricator's scope, and which are not

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OPTION 3 – Sample Calculations

Why is it important to communicate when design calculations are required for every connection?

- Providing charts with sample calculations allow the fabricator's engineer to take advantage of 303's Option 2 where the fabricator's detailer selects connections from one of a fabricator's-generated charts

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- Customer revisions and changes require significant effort in regard to revisions to submittals made prior to the change

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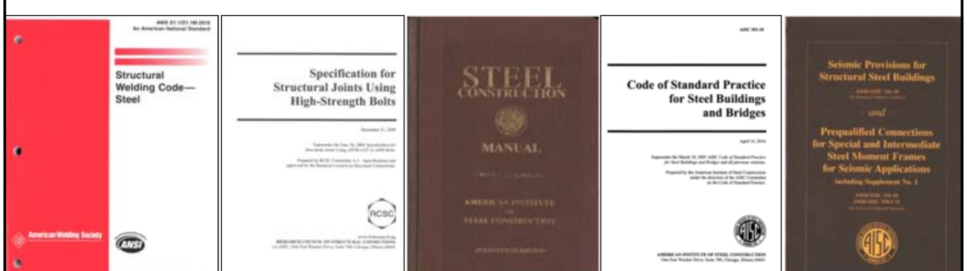
- The fabricator’s estimating department needs to accurately capture these costs

Specifications, Provisions, and Standards



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Be Clear about the Specifications and Standards

C. STRUCTURAL STEEL NOTES

1. THE DESIGN OF STRUCTURAL STEEL IS IN ACCORDANCE WITH THE REQUIREMENTS OF EITHER AISC–LRFD, AISC–335 OR AISC–HSS.

2. THE DESIGN AND CONSTRUCTION OF STEEL FRAMING IN LATERAL–FORCE RESISTING SYSTEM SHALL CONFORM TO PROVISIONS OF SECTION 2205.2.1 OR 2205.2.2 FOR APPROPRIATE SEISMIC DESIGN CATEGORY.

3. FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM TO THE REQUIREMENTS OF THE ABOVE AISC SPECIFICATION.

4. AISC SPECIFICATIONS FOR "LOAD AND RESISTANCE FACTOR DESIGN (LRFD) FOR STRUCTURAL STEEL IN BUILDINGS", LATEST EDITION, SHALL APPLY, EXCEPT AS MODIFIED BY THE NOTES, SCHEDULES AND DETAILS SHOWN ON THE STRUCTURAL DRAWINGS OR ANY [redacted]

5. ALL MATERIAL FOR STRUCTURAL STEEL SHAPES TO BE ASTM A992 HAVING A MINIMUM YIELD OF 50,000 PSI U.O.N. HSS SECTIONS MUST BE A500 GRADE B, YIELD STRENGTH = 46 KSI.

6. MATERIAL ACCEPTANCE OF STRUCTURAL STEEL SHALL CONFORM TO THE CERTIFICATION AND INSPECTION REQUIREMENTS OF CHAPTER 17, OF THE NEW YORK CITY BUILDING CODE BC 1704.3 AND TABLE 1704.3.

7. SUBMIT CHECKED SHOP DRAWINGS PREPARED BY A LICENSED PROFESSIONAL ENGINEER FOR APPROVAL. PRIOR TO SUBMITTAL OF DETAILED SHOP DRAWINGS,PROVIDE A SET OF JOB STANDARDS SHOWING ALL NECESSARY JOINT DETAILS. AFTER APPROVAL OF THESE STANDARDS,SUBMIT ERECTION PLANS INDICATING LOCATION OF JOINT AND MEMBER MARKINGS.

8. DESIGN REACTIONS NOT INDICATED ON PLAN FOR CONNECTIONS

   a) NON–COMPOSITE BEAMS
   BEAM TO BEAM AND BEAM TO COLUMN CONNECTIONS SHALL BE DESIGNED TO TRANSFER THE REACTION FOR A SIMPLY SUPPORTED, UNIFORMLY LOADED BEAM OF SAME SIZE, SPAN AND Fy AS LISTED IN THE TABLE OF UNIFORM LOAD CONSTANTS, AISC MANUAL OF STEEL CONSTRUCTION, NINTH EDITION, OR FOR THE REACTION SHOWN ON THE FRAMING PLAN, WHICHEVER IS GREATER. WHERE NO REACTION IS SHOWN ON THE FRAMING PLAN, CONNECTION SHALL TRANSFER THE REACTION AS NOTED ABOVE.

   b) COMPOSITE BEAMS (WITH STUDS)
   THE CONNECTIONS FOR COMPOSITE BEAMS WITH STUDS SHALL HAVE A CAPACITY OF 160% OF THE REACTION FOR A SIMPLY SUPPORTED, UNIFORMLY LOADED BEAM OF SAME SIZE, SPAN, Fy, AND ALLOWABLE UNIT STRESS AS LISTED IN THE TABLE OF UNIFORM LOAD CONSTANTS, AISC MANUAL OF STEEL CONSTRUCTION, NINTH EDITION, OR FOR THE REACTION SHOWN ON THE FRAMING PLAN, WHICHEVER IS GREATER.

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Be Clear about the Specifications and Standards

4. AISC SPECIFICATIONS FOR "LOAD AND RESISTANCE FACTOR DESIGN (LRFD) FOR STRUCTURAL STEEL IN BUILDINGS", LATEST EDITION, SHALL APPLY, EXCEPT AS MODIFIED BY THE NOTES, SCHEDULES AND DETAILS SHOWN ON THE STRUCTURAL DRAWINGS OR [redacted]

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Be Clear about the Specifications and Standards

For example, a project with no AISC 341 requirements:

Structural steel connections shall be in accordance with **AISC 360-05** following the **ASD** design methodology. All loads provided on drawings are **factored ASD loads**. All members labeled as **SFRS** shall be designed in accordance with **AISC 360-05**.

All bolted connections shall satisfy the requirements of **RCSC 2004**, and all welded connections shall be in accordance with **AWS D1.1-04**.

This should be consistent throughout the design documents!

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Be Clear about the Specifications and Standards

For example, a project with AISC 341 requirements:

Structural steel connections shall be in accordance with **AISC 360-10** following the **LRFD** design methodology. All loads provided on drawings are **factored LRFD loads**. All members labeled as **SFRS** shall be designed in accordance with **AISC 341-10**. All **moment connections labeled as SMF** shall be designed in accordance with **AISC 358-10**.

All bolted connections shall satisfy the requirements of **RCSC 2009**, and all welded connections shall be in accordance with **AWS D1.1-10** and **AWS D1.8-10**.

This should be consistent throughout the design documents!

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Coordinate Project Specifications, General Notes and Design Drawings

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Coordinate Project Specifications, General Notes and Design Drawings

2. SEISMIC:
LATITUDE = 39.015, LONGITUDE = -77.459
SITE CLASS C, OCCUPANCY CATEGORY: III, I = 1.25 (VOLUNTARY)
S_S = 0.158, S_1 = 0.051
F_a = 1.00, F_V = 1.00
S_{DS} = 0.15, S_{DI} = 0.034
SEISMIC DESIGN CATEGORY: A
ANALYSIS PROCEDURE: EQUIVALENT LATERAL FORCE PROCEDURE
R = 3.0 (ORDINARY CONCENTRIC BRACED FRAMES)
V = 0.053W (STRENGTH DESIGN), SITE SPECIFIC BASE SHEAR (VOLUNTARY)

68

Coordinate Project Specifications, General Notes and Design Drawings

2. SEISMIC:
LATITUDE = 39.015, LONGITUDE = -77.459
SITE CLASS C, OCCUPANCY CATEGORY: III, I = 1.25 (VOLUNTARY)
S_S = 0.158, S_1 = 0.051
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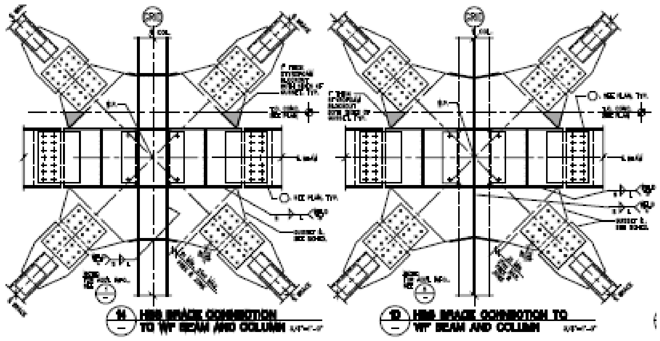


69

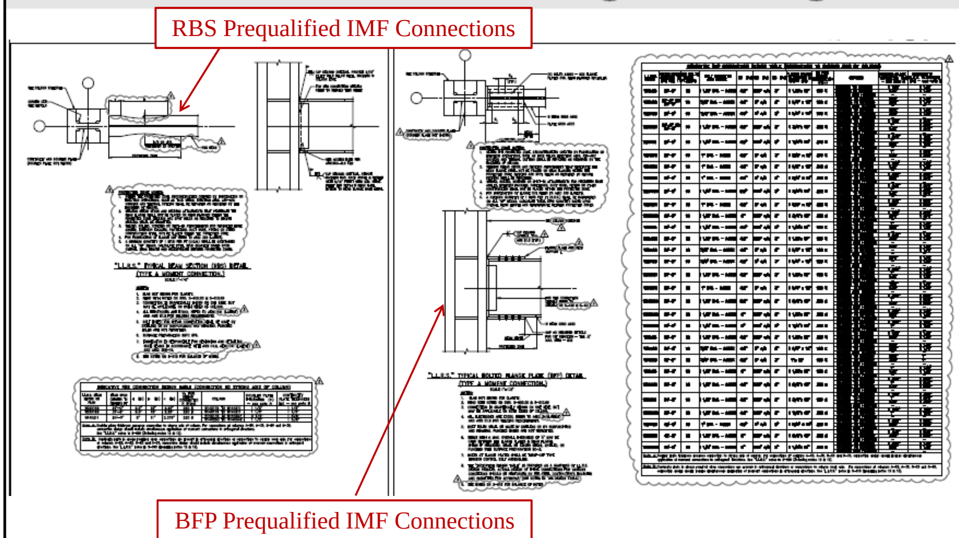
Coordinate Project Specifications, General Notes and Design Drawings

8. SEISMIC LOAD:

DESIGN SPECTRAL ACCEL. FOR SHORT PERIODS, SDS:	0.475
DESIGN SPECTRAL ACCEL. FOR 1-SEC PERIOD, SD1:	0.145
SITE CLASSIFICATION:	AS PER SITE SPECIFIC STUDY
SEISMIC IMPORTANCE FACTOR, I:	1.25
RESPONSE MODIFICATION COEFFICIENT, RW:	3
SYSTEM OVERSTRENGTH FACTOR, WO:	3
DEFLECTION AMPLIFICATION FACTOR, CD:	3
ALLOWABLE STORY DRIFT, DA	0.015Hsx
SEISMIC DESIGN CATEGORY:	C

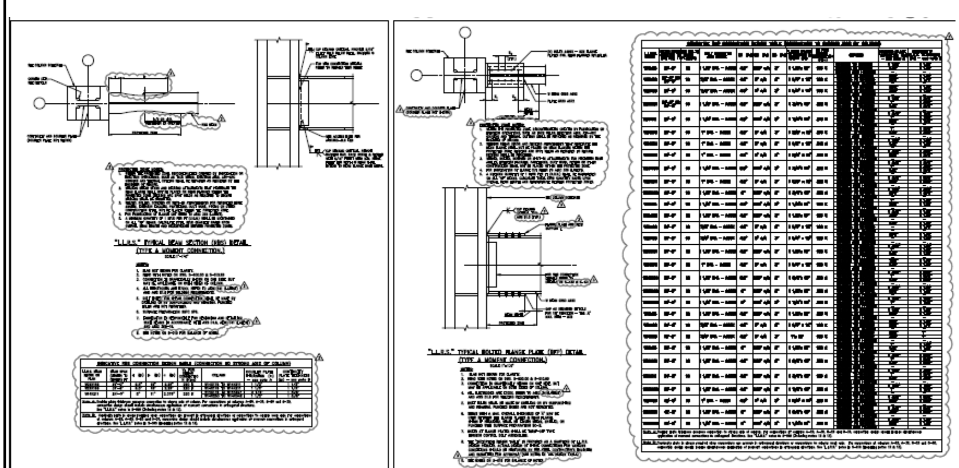
70

Coordinate Project Specifications, General Notes and Design Drawings



71

Coordinate Project Specifications, General Notes and Design Drawings



If "seismic detailing" is being used to satisfy progressive collapse requirements, state this in the general notes.

72

Is It EM or NOT?

73

Is It EM or NOT?

C. CONNECTIONS

1. ALL CONNECTIONS, EXCEPT FOR THOSE CONNECTIONS COMPLETELY DESIGNED ON THE DRAWINGS, SHALL BE DESIGNED AND DETAILED BY THE FABRICATOR. DETAILING SHALL BE PERFORMED USING RATIONAL ENGINEERING DESIGN AND STANDARD PRACTICE IN ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS. THE GENERAL DETAILS SHOWN ON THE DRAWINGS ARE CONCEPTUAL ONLY AND DO NOT INDICATE THE REQUIRED NUMBER OF BOLTS OR WELD SIZES, UNLESS SPECIFICALLY NOTED. THE CONTRACTOR SHALL SUBMIT ENGINEERING CALCULATIONS AND CONNECTION DETAIL DRAWINGS FOR EACH CONNECTION TYPE, MEMBER SIZE, AND REACTION INDICATED ON THE DRAWINGS FOR REVIEW BY THE ARCHITECT PRIOR TO THE SUBMITTAL OF THE STRUCTURAL STEEL SHOP DRAWINGS. AFTER REVIEW BY THE ARCHITECT, THESE DETAIL DRAWINGS SHALL BE UTILIZED AS THE STANDARD FOR FABRICATION AND SHOP DRAWING DETAILING. THE DESIGN CALCULATIONS SHALL BE PREPARED AND SEALED BY A QUALIFIED PROFESIONAL ENGINEER LICENSED IN THE STATE OF NEW YORK.

74

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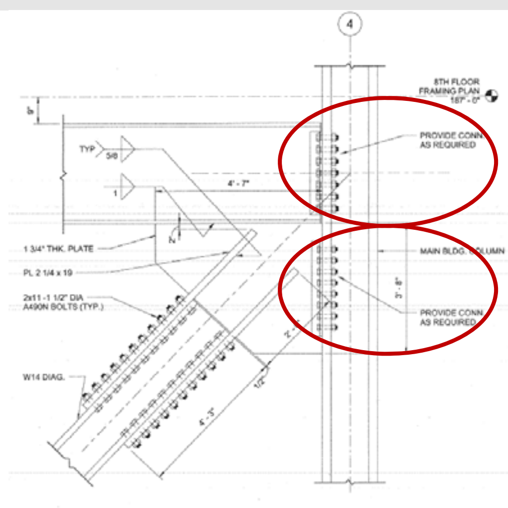
For those connections "completely designed:"

Add a note to those details stating that this detail is "not delegated."

75

Is It EM or NOT?

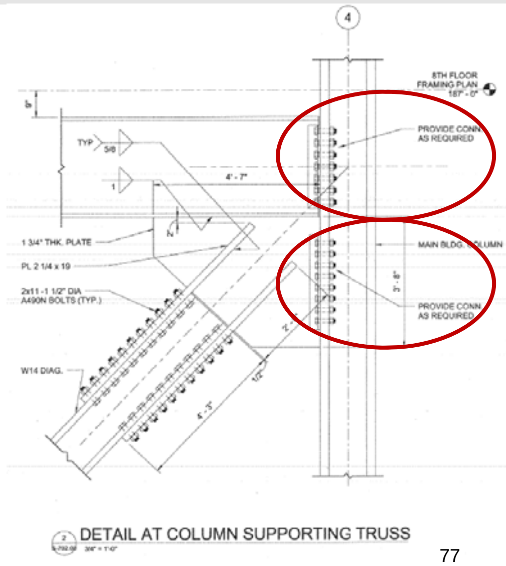


DETAIL AT COLUMN SUPPORTING TRUSS

76

Is It EM or NOT?

Incomplete details can be confusing, cause delays in the submit/review/ approve process, and potentially impact project schedule and budget



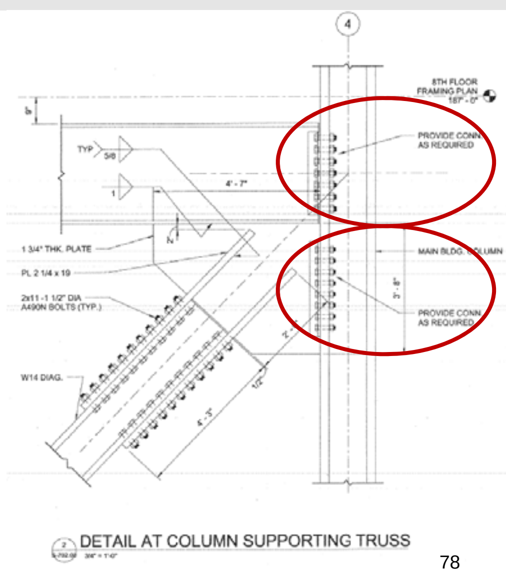
77

Is It EM or NOT?

Incomplete details can be confusing, cause delays in the submit/review/ approve process, and potentially impact project schedule and budget

All but the beam- and gusset-to-column appear to be "completely designed" by the EOR.

The beam- and gusset-to-column connections share part of the brace force load path.



78

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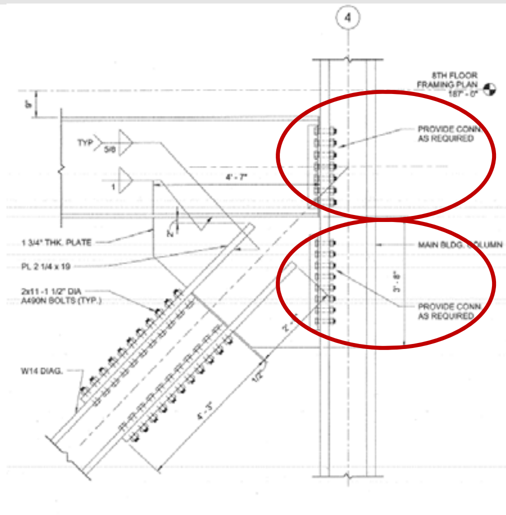
All but the beam- and gusset-to-column appear to be "completely designed" by the EOR.

The beam- and gusset-to-column connections share part of the brace force load path.

For what loads should these two locations be designed?



DETAIL AT COLUMN SUPPORTING TRUSS

79

Is It EM or NOT?

1.3 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using AISC 360.
2. Use LRFD; data are given at factored-load level.

SC-2 ALL CONNECTIONS, UNLESS INDICATED AS BEING FULLY DESIGNED ON THE STRUCTURAL DRAWINGS, SHALL BE DESIGNED AND DETAILED BY A LICENSED STRUCTURAL ENGINEER IN THE STATE WHERE THE PROJECT IS LOCATED. THE DESIGN AND DETAILING SHALL COMPLY WITH ALL APPLICABLE CODES AND SPECIFICATION SECTIONS. REFERENCE SHEET S6-40 FOR ADDITIONAL INFORMATION.

80

Is It EM or NOT?

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NOTES:

1. EXCEPT WHERE SPECIFICALLY NOTED, DETAILS ON THE S6-40 TO S6-70 SERIES DRAWINGS ARE CONSIDERED COMPLETELY DESIGNED AND SHALL NOT BE MODIFIED WITHOUT SPECIFIC WRITTEN APPROVAL FROM THE ENGINEER. REFER TO STRUCTURAL GENERAL NOTES "SS STRUCTURAL STEEL CONNECTIONS" AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS. WHERE DETAILING, FABRICATION REQUIREMENTS, ERECTION REQUIREMENTS OR CONTRACTOR'S PREFERENCES REQUIRE MODIFICATIONS TO THESE CONNECTION DESIGNS, FABRICATOR SHALL CONSULT ENGINEER.

11. CONTRACTOR'S OPTION TO USE ALTERNATE SHEAR CONNECTIONS THAN THOSE SHOWN ON DETAILS 3 THROUGH 6, THIS SHEET. CONTRACTOR SHALL PROVIDE CALCULATIONS FOR ANY ALTERNATE CONNECTIONS DEVELOPING SHEAR CAPACITY NOTED IN CHART.

81

Completeness

Concept details in the Design Documents are OK provided design intent and expectations are clearly communicated. This includes:

- Identifying critical connection geometry constraints
- Identifying the extent of connection designers' scope
- Sufficiently communicating connection design forces on drawings (i.e., shears. moments, transfer forces, etc.)
- Avoiding details that contain meaningless constraints that needlessly limit possible design options

82

Completeness

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- Identifying critical connection geometry constraints
- Identifying the extent of connection designers' scope
- Sufficiently communicating connection design forces on drawings (i.e., shears. moments, transfer forces, etc.)
- Avoiding details that contain meaningless constraints that needlessly limit possible design options

AISC Code of Standard Practice requires the following to be provided by the SEoR:

83

AISC 303 COSP on Information Provided

Items taken from AISC 303-1 Section 3.1

- Size, Selection, material grade and location of all members;
- All geometry and work points;
- Floor elevations;
- Column centers and offsets;
- Camber requirements;
- Joining requirements between elements of built-up members;
- Column stiffeners/continuity plates;
- Column web doubler plates;
- Bearing stiffeners in beams and girders;
- Web reinforcement;
- Data concerning loads, including shears, moments, axial forces, and **transfer forces**

84

AISC 303 COSP on Information Provided

<u>Is data provided at service load level or factored load level</u>;

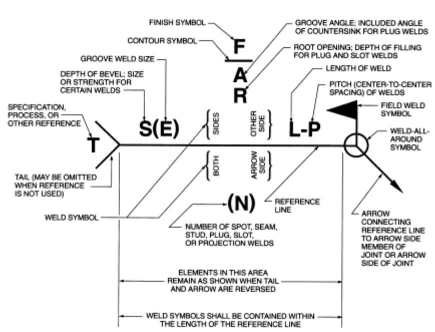
ASD or LRFD design methodology;

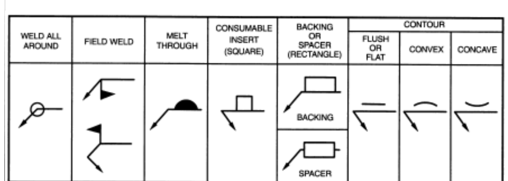
<u>Any restrictions on types of connections that can be used</u>;

Any substantiating information to be shown on shop or erection drawings

85

Welding Requirements





Figures 2 and 3 from AWS A2.4-98 Standard Symbols for Welding, Brazing, and Nondestructive Examination

86

Welding Requirements

Structural EoRs should be cautious in providing too specific weld information unless they understand the implications.

What weld size is required here?

AISC minimum welds?

Is there a specific load that needs to be transferred?

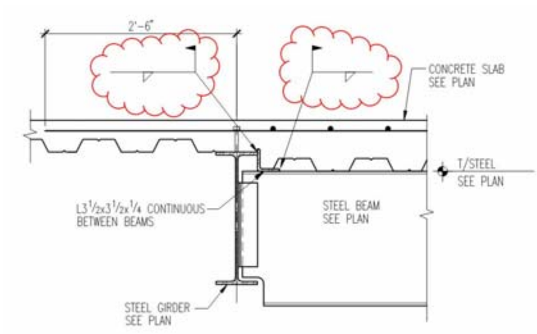
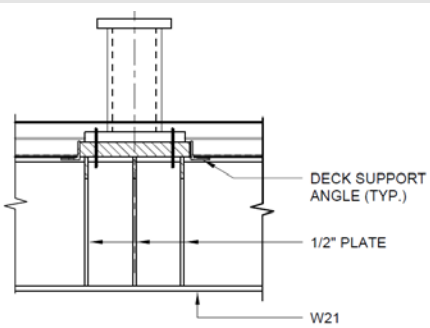


Figure courtesy of Susan Burmeister, P.E.

87

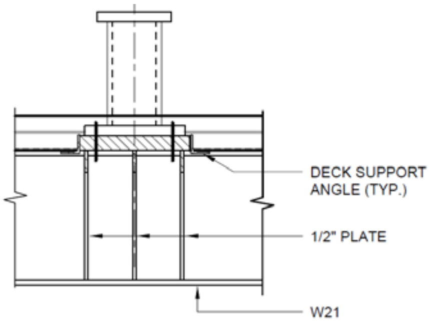
Welding Requirements



This detail suggests that (3)- ½" stiffener plates must be provided.

88

Welding Requirements

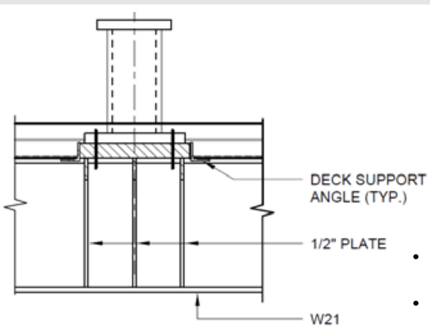


This detail suggests that (3)- ½” stiffener plates must be provided.

How should they be attached to the beam web and flanges?

89

Welding Requirements



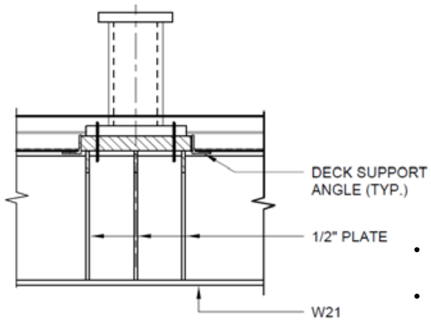
This detail suggests that (3)- ½” stiffener plates must be provided.

How should they be attached to the beam web and flanges?

- Minimum fillet welds?
- Maybe fillet welds sized for a particular load?

90

Welding Requirements



This detail suggests that (3)- ½" stiffener plates must be provided.

How should they be attached to the beam web and flanges?

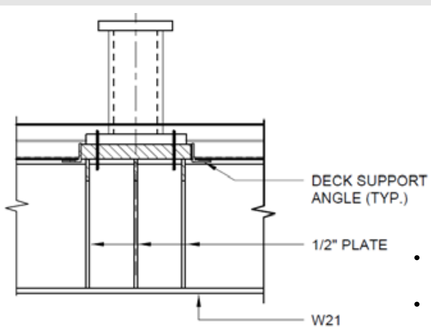
- Minimum fillet welds?
- Maybe fillet welds sized for a particular load?

Option 1: Provide the required weld size and type

Option 2: Provide the required load so the weld size and type can be determined.

91

Welding Requirements



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How should they be attached to the beam web and flanges?

- Minimum fillet welds?
- Maybe fillet welds sized for a particular load?

Option 1: Provide the required weld size and type

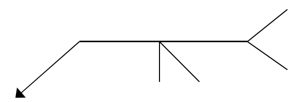
Option 2: Provide the required load so the weld size and type can be determined.

With the load provided, is it okay for the designer to evaluate if the stiffener is even needed?

92

The New Groove Weld Symbol

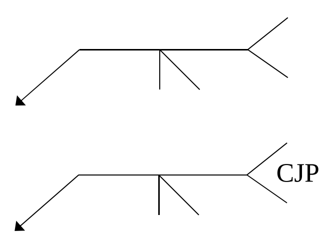
What does this weld symbol convey?



The New Groove Weld Symbol

What does this weld symbol convey?

…and this one??



The New Groove Weld Symbol

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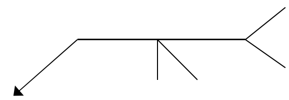
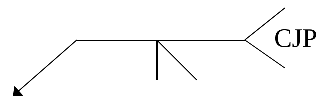


…and this one??



Without the CJP tail note, the designer will provide whatever weld is needed to develop the base material in tension and shear…

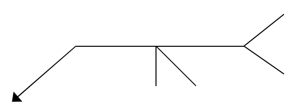
…will you be getting what you wanted?

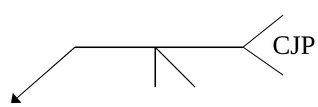
95

The New Groove Weld Symbol

2.2.5.3 Welding Symbols. The contract documents shall show CJP or PJP groove weld requirements. Contract documents do not need to show groove type or groove dimensions. The welding symbol without dimensions and with "CJP" in the tail designates a CJP weld as follows:

The welding symbol without dimension and without CJP in the tail designates a weld that will develop the adjacent base metal strength in tension and shear. A welding symbol for a PJP groove weld shall show dimensions enclosed in parentheses below "(E_1)" and/or above "(E_2)" the reference line to indicate the groove weld sizes on the arrow and other sides of the weld joint, respectively, as shown below:





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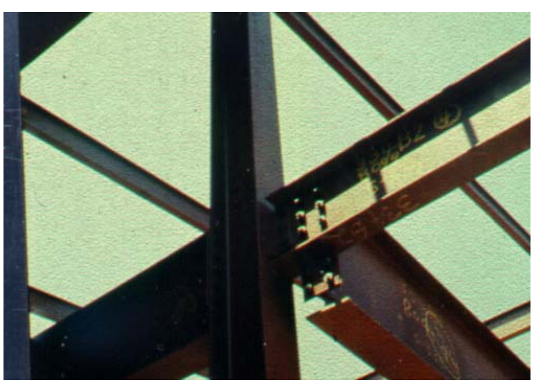
Design Loads, Moments, Transfer Forces, etc.

SEoR should provide all forces necessary to complete the connection design accurately and economically.

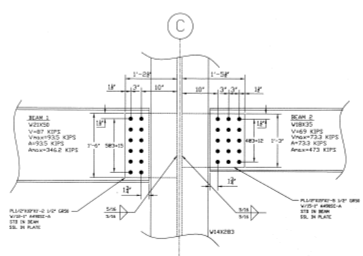
97

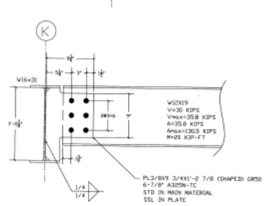
Design Loads, Moments, Transfer Forces, etc.

SHEAR CONNECTIONS



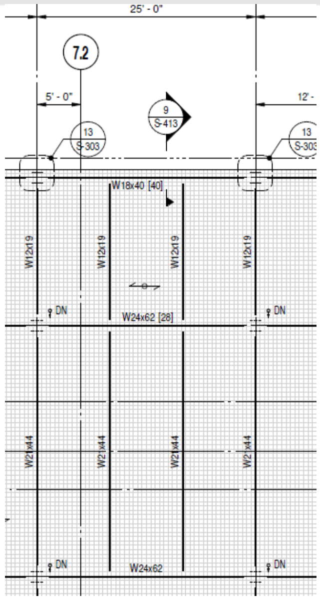
That Darn UDL





98

Design Loads, Moments, Transfer Forces, etc.



8. DESIGN REACTIONS NOT INDICATED ON PLAN FOR CONNECTIONS

   a) NON-COMPOSITE BEAMS BEAM TO BEAM AND BEAM TO COLUMN CONNECTIONS SHALL BE DESIGNED TO TRANSFER THE REACTION FOR A SIMPLY SUPPORTED, UNIFORMLY LOADED BEAM OF SAME SIZE, SPAN AND Fy AS LISTED IN THE TABLE OF UNIFORM LOAD CONSTANTS, AISC MANUAL OF STEEL CONSTRUCTION, NINTH EDITION, OR FOR THE REACTION SHOWN ON THE FRAMING PLAN, WHICHEVER IS GREATER. WHERE NO REACTION IS SHOWN ON THE FRAMING PLAN, CONNECTION SHALL TRANSFER THE REACTION AS NOTED ABOVE.

   b) OMPOSITE BEAMS (WITH STUDS) THE CONNECTIONS FOR COMPOSITE BEAMS WITH STUDS SHALL HAVE A CAPACITY OF 160% OF THE REACTION FOR A SIMPLY SUPPORTED, UNIFORMLY LOADED BEAM OF SAME SIZE, SPAN, Fy, AND ALLOWABLE UNIT STRESS AS LISTED IN THE TABLE OF UNIFORM LOAD CONSTANTS, AISC MANUAL OF STEEL CONSTRUCTION, NINTH EDITION, OR FOR THE REACTION SHOWN ON THE FRAMING PLAN, WHICHEVER IS GREATER.

99

Design Loads, Moments, Transfer Forces, etc.

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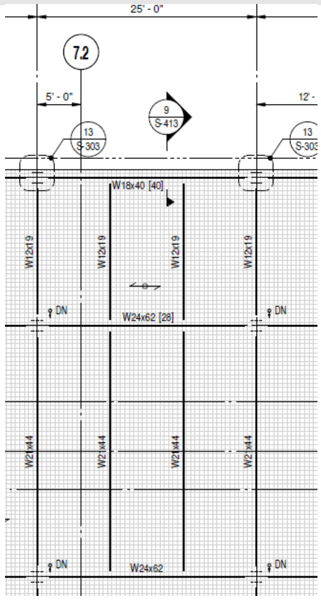
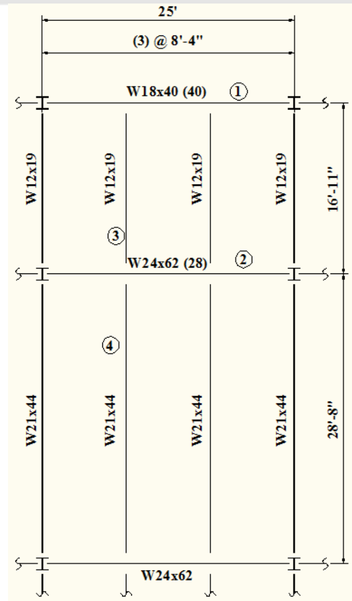
100

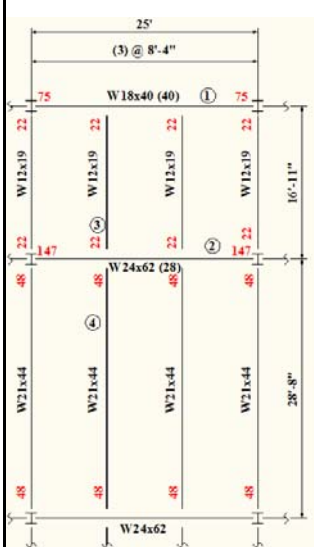
Design Loads, Moments, Transfer Forces, etc.





101

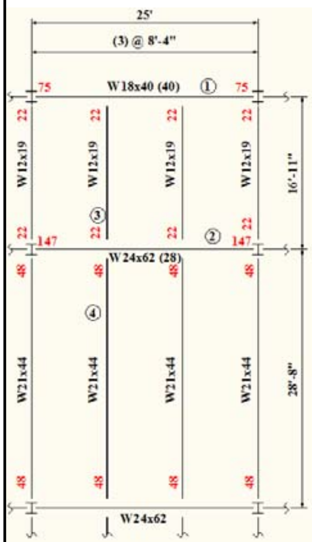
Design Loads, Moments, Transfer Forces, etc.

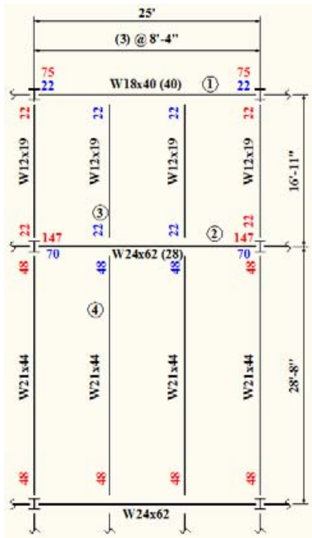


The **red values** shown at beam ends are the required strengths pulled from Table 3-6 of the AISC manual (13th ED.), based on project requirements

102

Design Loads, Moments, Transfer Forces, etc.



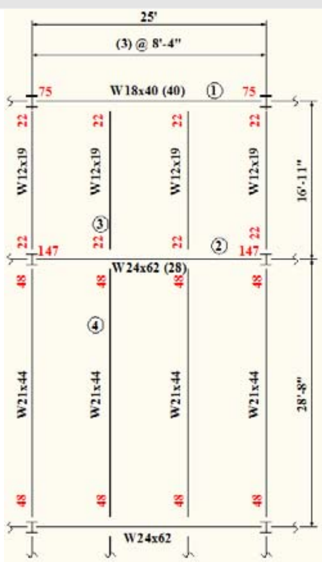


The **red values** shown at beam ends are the required strengths pulled from Table 3-6 of the AISC manual (13th ED.), based on project requirements

The **blue values** shown at beam ends are maximum girder reactions that the beams can deliver.

103

Design Loads, Moments, Transfer Forces, etc.



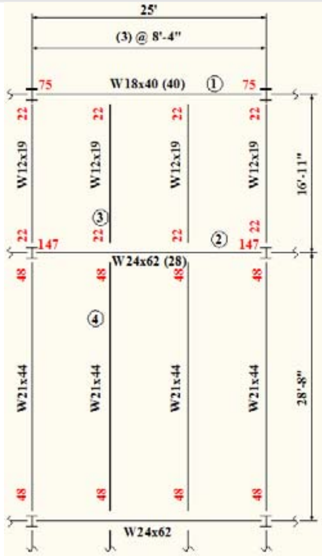
Let q_i = maximum floor load based on provided shear strength:

Girder 1: $$q_1 = \frac{2R_1}{L_1(TL)_1} = \frac{(2)(75kips)(1{,}000lbs/kip)}{(25\,ft)(8.46\,ft)} = 709\,psf$$

Girder 2: $$q_2 = \frac{2R_2}{L_2(TL)_2} = \frac{(2)(147kips)(1{,}000lbs/kip)}{(25\,ft)(22.8\,ft)} = 516\,psf$$

104

Design Loads, Moments, Transfer Forces, etc.



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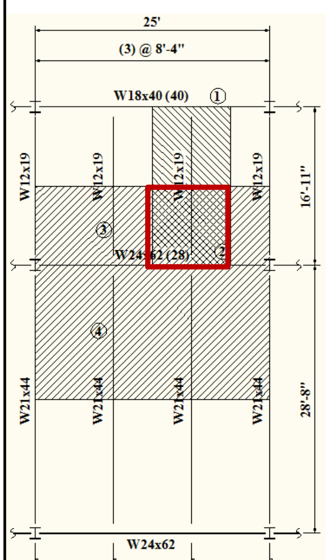
It's possible, but unlikely, that the design floor load for this commercial building approached 516 *psf* let alone 709 *psf*.

105

Design Loads, Moments, Transfer Forces, etc.

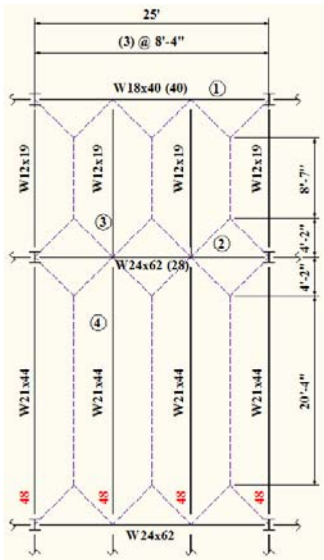


I've been told that this isn't a fair evaluation, that this type of tributary analysis is an overly conservative calculation based on a simplified and conservative approximation of a member's tributary area.

So, let's sharpen the pencil!

106

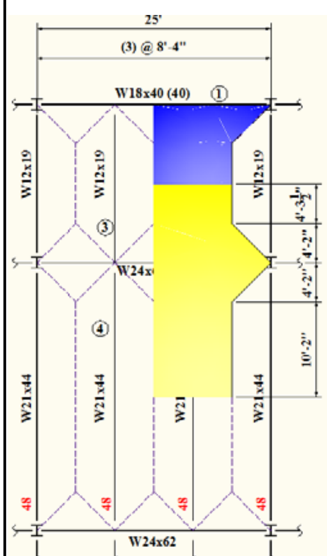
Design Loads, Moments, Transfer Forces, etc.



Evaluate q_i based on a more detailed tributary area

107

Design Loads, Moments, Transfer Forces, etc.



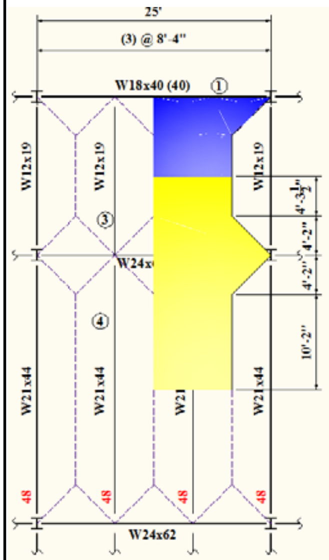
Let q_i = maximum floor load based on provided shear strength:

Girder 1:
$$q_1 = \frac{R_1}{(TA)_1} = \frac{(75kips)(1{,}000lbs/kip)}{(8.46\,ft)(8.33\,ft)+(0.5)(4.167\,ft)(4.167\,ft)}$$
$$q_1 = 947\,psf$$

Girder 2:
$$q_2 = \frac{R_2}{(TA)_2} = \frac{(147kips)(1{,}000lbs/kip)}{(22.8\,ft)(8.33\,ft)+(4.167\,ft)(4.167\,ft)}$$
$$q_2 = 709\,psf$$

108

Design Loads, Moments, Transfer Forces, etc.



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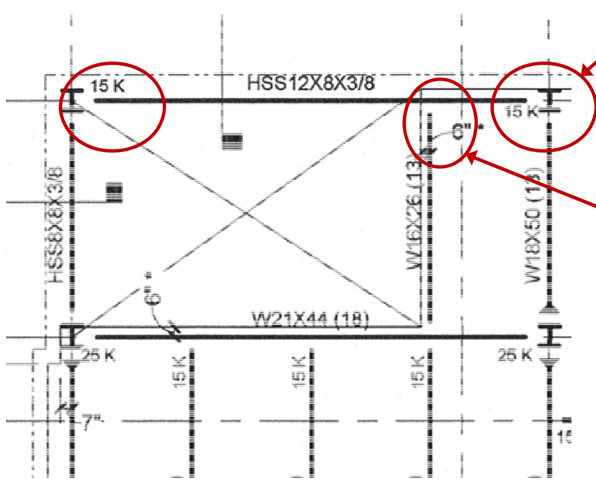
The theoretical tributary area produces an appreciably larger design floor load!

109

Design Loads, Moments, Transfer Forces, etc.



Supporting member reactions total 30 kips

Where no load is posted, connection designed for a reaction due to 1.5UDL;

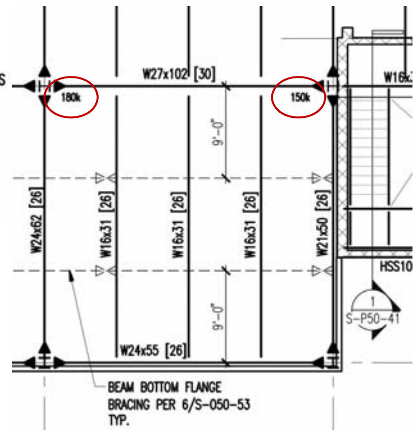
In this case, 62 kips!

110

Design Loads, Moments, Transfer Forces, etc.

If for some reason, actual loads cannot be provided, an option other than UDL can be providing reactions by beam size in a tabular form and only noting exceptions is an option

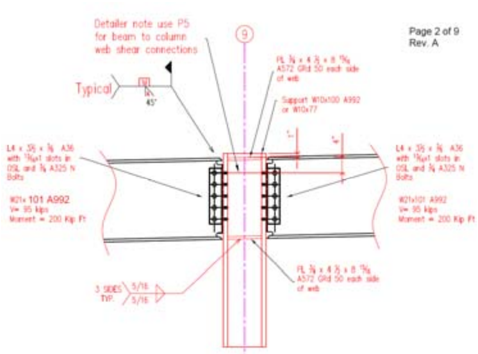
9. UNLESS NOTED OTHERWISE, ASSUME THE FOLLOWING ULTIMATE (LRFD FACTORED) REACTIONS AT BEAM ENDS:
   - W6 BEAMS: USE R=15 KIPS
   - W8 & W10 BEAMS: USE R=25 KIPS
   - W12 & W14 BEAMS: USE R=45 KIPS
   - W16 BEAMS: USE R=60 KIPS
   - W18 & W21 BEAMS: USE R=75 KIPS
   - W24 BEAMS: USE R=95 KIPS
   - W27 BEAMS: USE R=120 KIPS
   - W30 AND LARGER BEAMS: USE R=200 KIPS

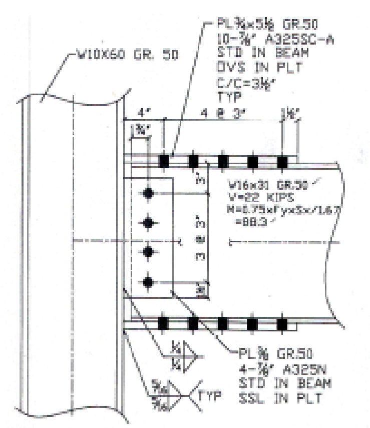


111

Design Loads, Moments, Transfer Forces, etc.

MOMENT CONNECTIONS





112

Design Loads, Moments, Transfer Forces, etc.

6. Web Panel Zone Shear

This section applies to *double-concentrated forces* applied to one or both flanges of a member at the same location.

The *available strength* of the web *panel zone* for the *limit state* of *shear yielding* shall be determined as follows:

$\phi = 0.90$ (LRFD) $\quad \Omega = 1.67$ (ASD)

The *nominal strength*, R_n, shall be determined as follows:

(a) When the effect of panel-zone deformation on frame *stability* is not considered in the analysis:

(i) For $P_r \le 0.4P_c$

$$R_n = 0.60F_y d_c t_w \qquad \text{(J10-9)}$$

(ii) For $P_r > 0.4P_c$

$$R_n = 0.60F_y d_c t_w \left(1.4 - \frac{P_r}{P_c}\right) \qquad \text{(J10-10)}$$

(b) When frame stability, including plastic panel-zone deformation, is considered in the analysis:

(i) For $P_r \le 0.75P_c$

$$R_n = 0.60F_y d_c t_w \left(1 + \frac{3b_{cf}t_{cf}^2}{d_b d_c t_w}\right) \qquad \text{(J10-11)}$$

(ii) For $P_r > 0.75P_c$

$$R_n = 0.60F_y d_c t_w \left(1 + \frac{3b_{cf}t_{cf}^2}{d_b d_c t_w}\right)\left(1.9 - \frac{1.2P_r}{P_c}\right) \qquad \text{(J10-12)}$$

(taken for AISC 360-05)

Four different equations can be used to compute panel zone strength; each with significant difference in calculated strength.

113

Design Loads, Moments, Transfer Forces, etc.

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For a proper panel-zone evaluation, the designer needs to know if the effect on panel-zone deformation on frame stability has been considered.

114

Design Loads, Moments, Transfer Forces, etc.

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Four different equations can be used to compute panel zone strength; each with significant difference in calculated strength.

For a proper panel-zone evaluation, the designer needs to know if the effect on panel-zone deformation on frame stability has been considered.

Furthermore, the designer must compute the axial capacity of the column, P_c; the term KL, needed to compute P_c, needs to be provided (potentially for each MC location)

115

Design Loads, Moments, Transfer Forces, etc.

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Furthermore, the designer must compute the axial capacity of the column, P_c; the term KL, needed to compute P_c, needs to be provided (potentially for each MC location)

A proper evaluation takes considerable design time; time not usually available during the estimating phase

116

Design Loads, Moments, Transfer Forces, etc.

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(taken for AISC 360-05)

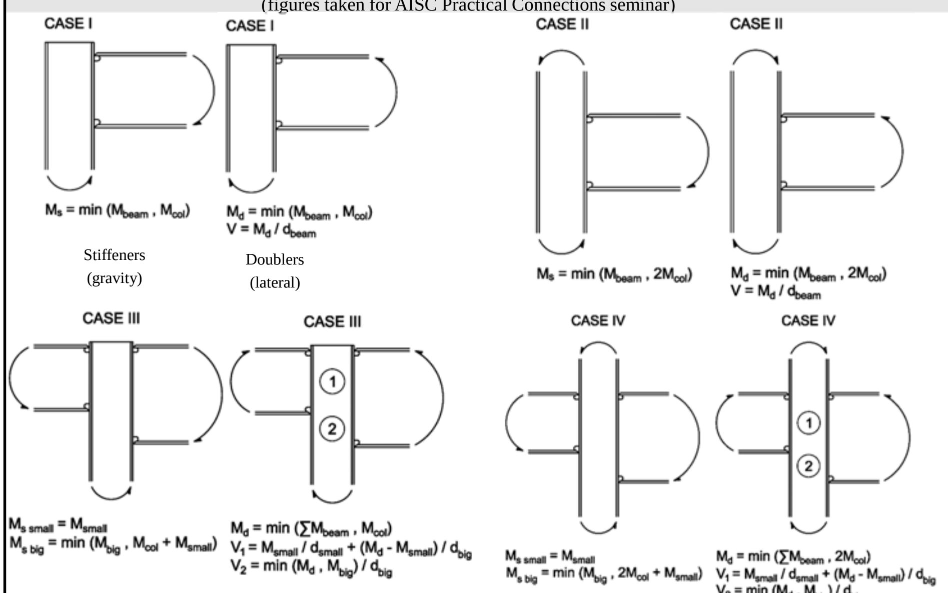
This, among other considerations, is why the COSP requires the SEoR to identify where web doubler plates are required

Similarly, the COSP requires the SEoR to identify where continuity plates are required

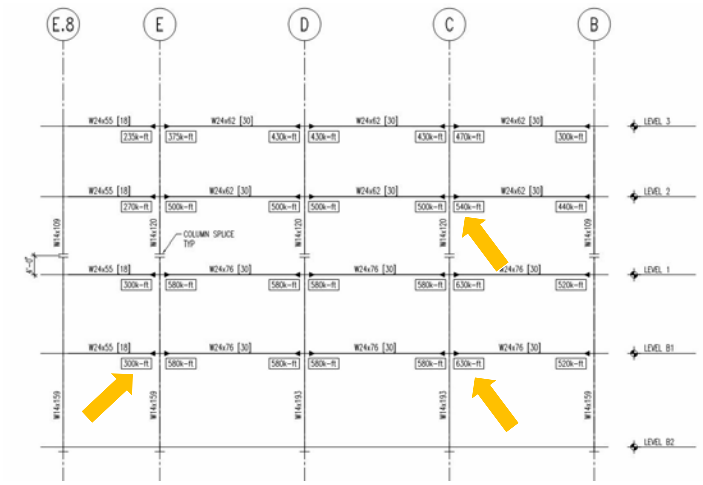
117

Design Loads, Moments, Transfer Forces, etc.

(figures taken for AISC Practical Connections seminar)



Design Loads, Moments, Transfer Forces, etc.



W24x55:
ϕMp = 503 k-ft
vs. 300 k-ft

W24x62:
ϕMp = 574 k-ft
vs. 540 k-ft

W24x76:
ϕMp = 750 k-ft
vs. 630 k-ft

Member capacity design does not just impact the size of the connection – it has a direct impact on evaluations for continuity and web doubler plates

119

Design Loads, Moments, Transfer Forces, etc.

W14x90 Column with 1.5” thick continuity plates

Note distortion in column flanges due to welding

120

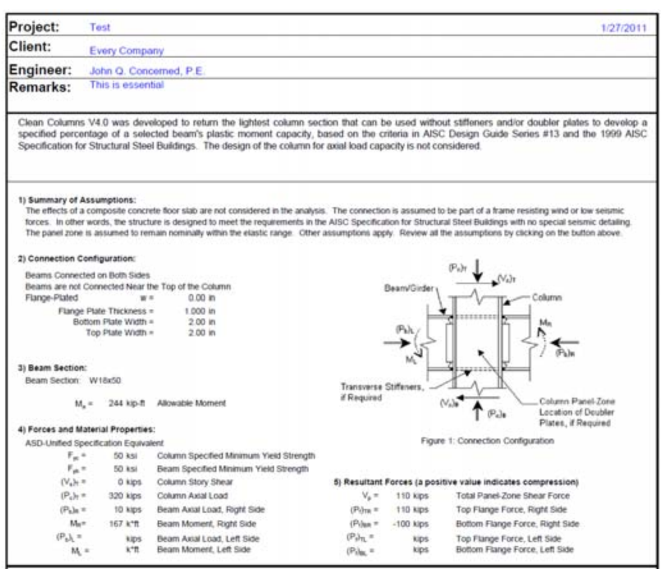
Design Loads, Moments, Transfer Forces, etc.

Clean columns should be a goal!

Choose beam-column combinations to minimize, if not eleminate, continuity and web doubler plates.

<u>AISC provides a free Excel program that allows the EOR to evaluate the need for continuity plates web doubler plates easily and efficiently</u> 121

Design Loads, Moments, Transfer Forces, etc.



Project:	Test	1/27/2011
Client:	Every Company	
Engineer:	John Q. Concerned, P.E.	
Remarks:	This is essential	

Clean Columns V4.0 was developed to return the lightest column section that can be used without stiffeners and/or doubler plates to develop a specified percentage of a selected beam's plastic moment capacity, based on the criteria in AISC Design Guide Series #13 and the 1999 AISC Specification for Structural Steel Buildings. The design of the column for axial load capacity is not considered.

1) Summary of Assumptions:
The effects of a composite concrete floor slab are not considered in the analysis. The connection is assumed to be part of a frame resisting wind or low seismic forces. In other words, the structure is designed to meet the requirements in the AISC Specification for Structural Steel Buildings with no special seismic detailing. The panel zone is assumed to remain nominally within the elastic range. Other assumptions apply. Review all the assumptions by clicking on the button above.

2) Connection Configuration:
Beams Connected on Both Sides
Beams are not Connected Near the Top of the Column
Flange-Plated w = 0.00 in
Flange Plate Thickness = 1.000 in
Bottom Plate Width = 2.00 in
Top Plate Width = 2.00 in

Figure 1: Connection Configuration

3) Beam Section:
Beam Section: W18x50

M_a = 244 kip-ft Allowable Moment

4) Forces and Material Properties:
ASD-Unified Specification Equivalent

F_{yc} =	50 ksi	Column Specified Minimum Yield Strength
F_{yb} =	50 ksi	Beam Specified Minimum Yield Strength
$(V_u)_T$ =	0 kips	Column Story Shear
$(P_u)_T$ =	320 kips	Column Axial Load
$(P_b)_R$ =	10 kips	Beam Axial Load, Right Side
M_R =	167 k*ft	Beam Moment, Right Side
$(P_b)_L$ =	kips	Beam Axial Load, Left Side
M_L =	k*ft	Beam Moment, Left Side

5) Resultant Forces (a positive value indicates compression)

V_p =	110 kips	Total Panel-Zone Shear Force
$(P_f)_{TR}$ =	110 kips	Top Flange Force, Right Side
$(P_f)_{BR}$ =	-100 kips	Bottom Flange Force, Right Side
$(P_f)_{TL}$ =	kips	Top Flange Force, Left Side
$(P_f)_{BL}$ =	kips	Bottom Flange Force, Left Side

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Design Loads, Moments, Transfer Forces, etc.

6) Column Design Results:

	Lightest W10	Lightest W12	Lightest W14	Lightest W16	Lightest W18
No Stiffener Plates Required	**W10x68**	**W12x79**	**W14x74**	**W16x77**	**W18x71**
No Doubler Plates Required	**W10x88**	**W12x87**	**W14x82**	**W16x77**	**W18x65**
No Stiffener Plates or Doubler Plates Required	**W10x88**	**W12x87**	**W14x82**	**W16x77**	**W18x71**

This spreadsheet has been prepared in accordance with information made available to the American Institute of Steel Construction, Inc., AISC Marketing, LLC, and the Steel Solutions Center, LLC at the time of its preparation. While it is believed to be accurate, it has not been prepared for conventional use as an engineering or construction document and should not be used or relied upon for any specific application without competent professional examination and verification of its accuracy, suitability and applicability by a licensed engineer, architect or other professional. AISC, AISCM, and SSC disclaim any liability arising from information provided by others or from the unauthorized use of the information contained in this spreadsheet.

Clean column is a great and essential tool for final selection size decisions for beams and columns

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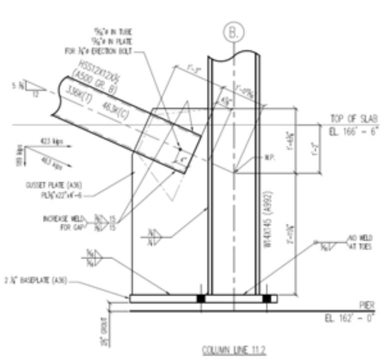
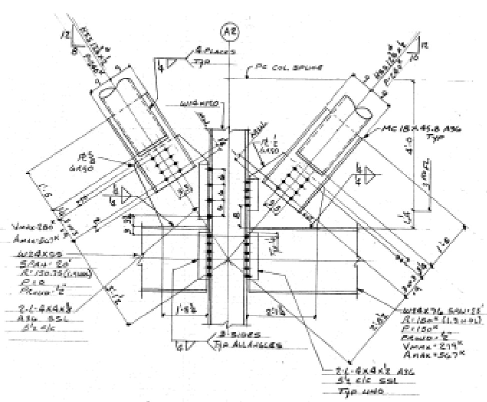
Design Loads, Moments, Transfer Forces, etc.

BRACE CONNECTIONS AND TRANSFER FORCES





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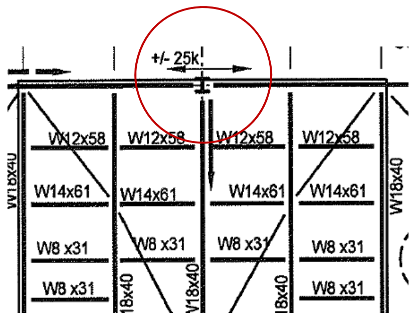
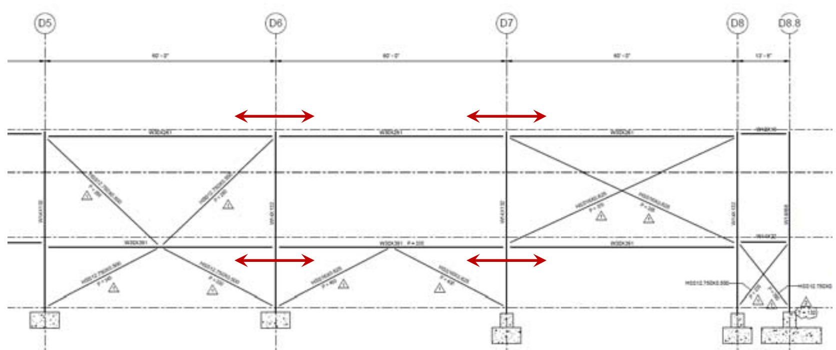
Design Loads, Moments, Transfer Forces, etc.



Show transfer forces

125

Design Loads, Moments, Transfer Forces, etc.



If you don't give direction regarding transfer forces…

…will the connection designer ask…

…will the connection designer have the expertise to recognize that it could be a concern?

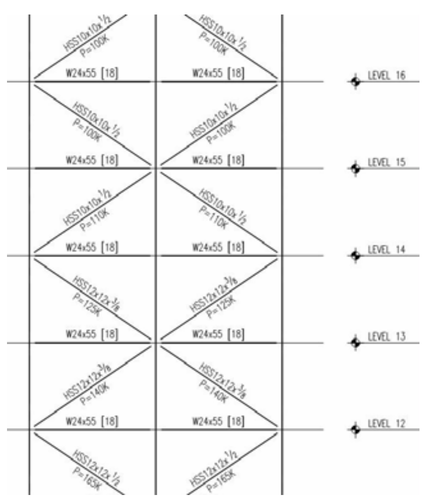
126

Design Loads, Moments, Transfer Forces, etc.

127

Figure courtesy of Tony Hazel, P.E.

Design Loads, Moments, Transfer Forces, etc.

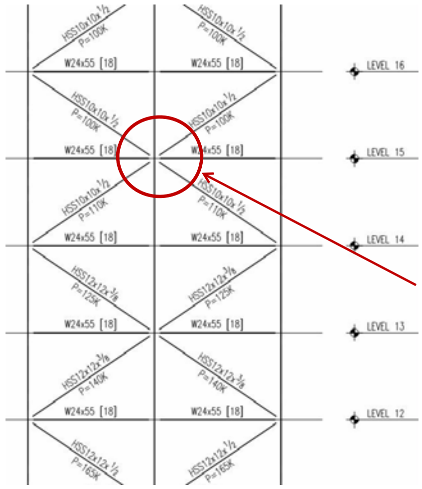


Forces shown are worst case envelope force and are noted to be tension or compression for connection design.

128

Figure courtesy of Tony Hazel, P.E.

Design Loads, Moments, Transfer Forces, etc.



Forces shown are worst case envelope force and are noted to be tension or compression for connection design.

At a joint like this, how is the connection designer expected to combine these forces at the beam-to-column interface?

129

Figure courtesy of Tony Hazel, P.E.

The Design, Submit, & Approval Process

Structural Engineers, Contractors, Fabricators, and Connection Designers should seek to establish open lines of communication early in construction phase of project.

130

The Design, Submit, & Approval Process

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Fabricators or connection designers that want to stray from the Design Documents should seek approval for changes to concepts from the SEoR prior to investing significant resources.

131

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However, enough work needs to be done to be confident that the proposed design/detail works.

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However, enough work needs to be done to be confident that the proposed design/detail works.

SEoRs should evaluate suggestions with an open mind.

133

The Design, Submit, & Approval Process

Fabricators and connection designers should recognize that SEoRs are less likely to approve changes, regardless of the merit, if they require the SEoR to perform additional work as it is traditionally difficult for the SEoR to receive compensation for revisions.

134

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Design Drawings should identify any limitations on the use of standard connection concepts.

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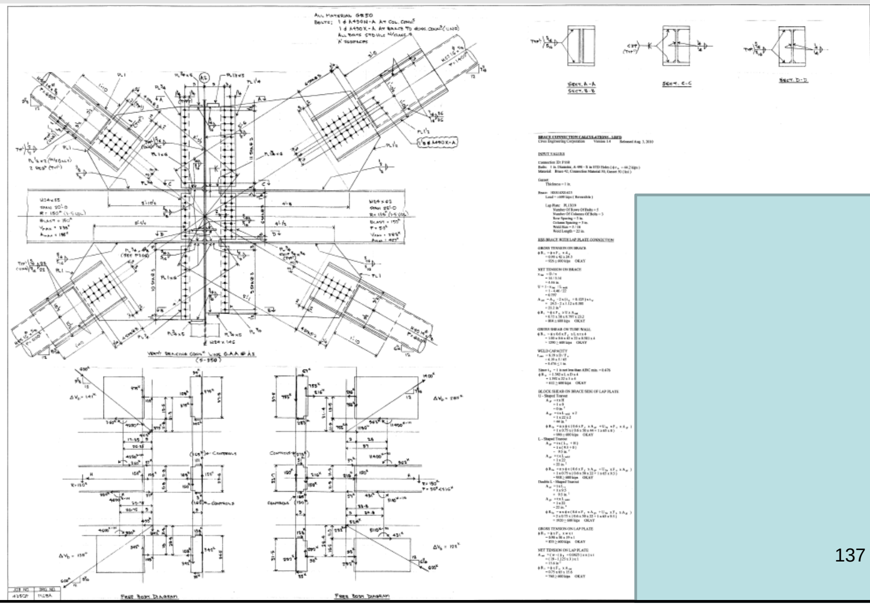
Where possible, Design Drawings should provide connection designer flexibility to develop connection details consistent with fabricator's shop practices.

136

The Design, Submit, & Approval Process



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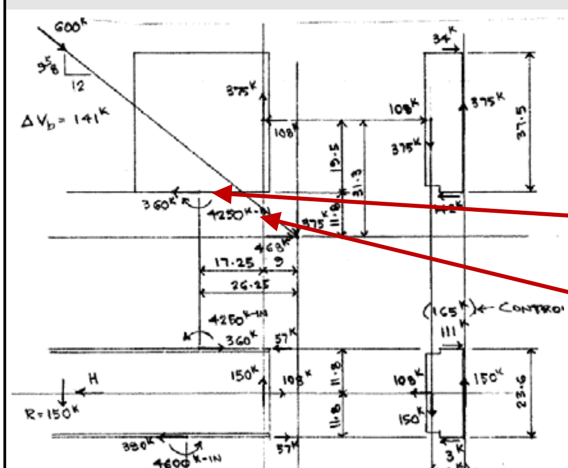
The Design, Submit, & Approval Process



TOP GUSSET TO BEAM CONNECTION

GROSS SHEAR ON GUSSET AT HORIZONTAL SECTION

$\phi R_v = \phi \times 0.6 \times F_y \times L \times t$

$= 1.00 \times 0.6 \times 50 \times 34.5 \times 1$

$= 1040 > 360$ kips OKAY

GROSS AXIAL ON GUSSET AT HORIZONTAL SECTION

$T_n = 4 \times | M_b | / L + | (V_b + \Delta V_b) |$

$= 4 \times | -4250 | / 34.5 + | (141 + -140) |$

$= 492$ kips

$\phi T_y = \phi \times F_y \times L \times t_p$

$= 0.90 \times 50 \times 34.5 \times 1$

$= 1550 \geq 492$ kips OKAY

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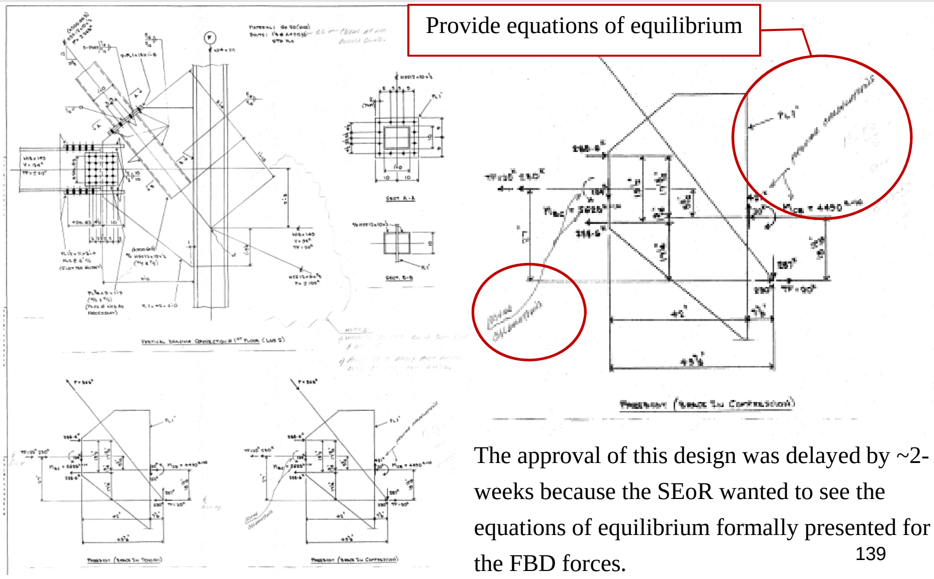
The Design, Submit, & Approval Process

Provide equations of equilibrium



The approval of this design was delayed by ~2-weeks because the SEoR wanted to see the equations of equilibrium formally presented for the FBD forces.

139

The Design, Submit, & Approval Process

Submit / review / approval process **is not** the appropriate vehicle for confirming connection design decisions with the SEoR.

140

The Design, Submit, & Approval Process

Make sure the RFI to the Contractor clearly describes the question. SEoRs often receive RFIs where the question asked does not reflect the question intended.

141

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Being clear and concise in the RFI, increases the probability that the SEoR's response will be pertinent to the intended question.

142

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Make sure the RFI to the Contractor clearly describes the question. SEoRs often receive RFIs where the question asked does not reflect the question intended.

Being clear and concise in the RFI, increases the probability that the SEoR's response will be pertinent to the intended question.

Design team is responsible for answering RFI's completely, and in a timely manner.

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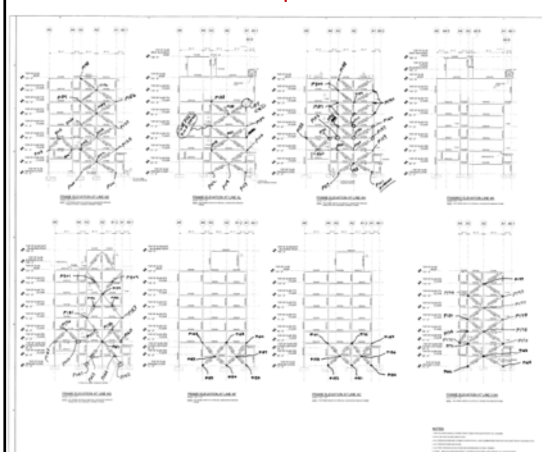
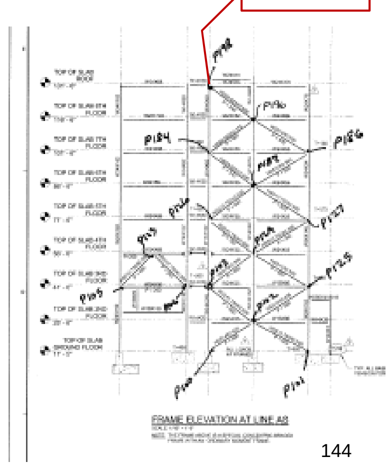
The Design, Submit, & Approval Process

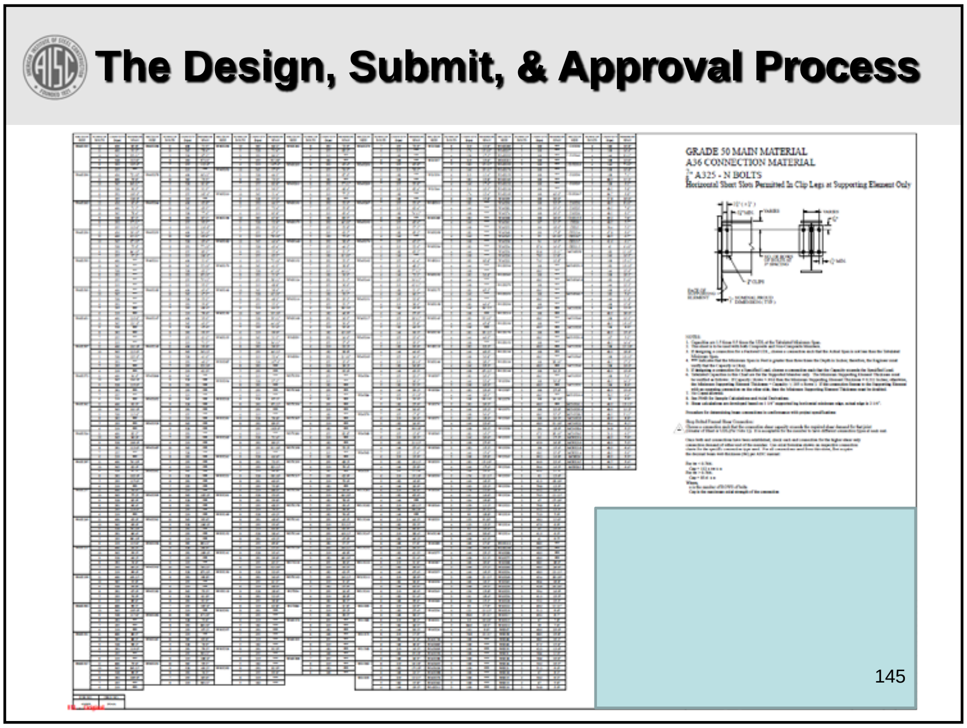
Maps the calculations shown on P192 to the specific location in the structure

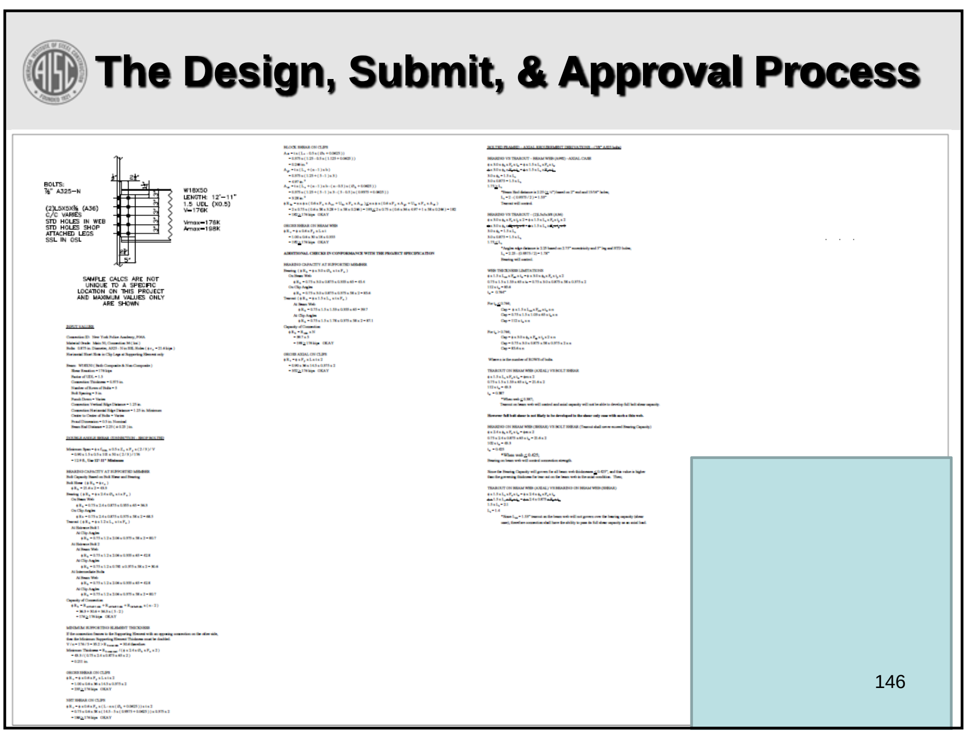
P192





144


The Design, Submit, & Approval Process
GRADE 50 MAIN MATERIAL
A36 CONNECTION MATERIAL
A325 - N BOLTS
145


The Design, Submit, & Approval Process
SAMPLE CALCS ARE NOT UNIQUE TO A SPECIFIC LOCATION ON THIS PROJECT AND MAXIMUM VALUES ONLY ARE SHOWN
146

It's a Team Effort, Let's Respect Each Other

The SEoR:

- Can not shift full responsibility of connection design to connection designer
- May have concerns or insight to detail concepts which are not readily apparent to the connection designer
- Should do enough work in establishing concepts to verify they are constructible and will work for the loads
- Should be willing to consider fabricator / connection designer suggestions
- Are the ones intimate with the global response and performance objectives
- It's their structure; no one knows more about the structure than the SEoR!

147

It's a Team Effort, Let's Respect Each Other

Fabricators and connection designers:

- Deal with steel connection designs every day
- Should be treated as a resource to SEoRs
- Can provide valuable input and suggestions on how to simplify construction and/or reduce costs
- Should not be unnecessarily restricted on connection design approaches if they share responsibility
- Should not make assumptions about connection loads beyond what is indicated in the Design Drawings

148

The "Manual" and Design Guides are not the Last Word

ANSI/AISC 360-10, Specification For Structural Steel Buildings, states:

> *Alternative methods of analysis and design are permitted, provided such alternative methods or criteria are acceptable to the authority having jurisdiction.*

The preface in the AISC Design Examples (14.0), states:

The primary objective of these design examples is to provide illustrations of the use of the 2010 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-10) and the 14th Edition of the AISC *Steel Construction Manual*. The design examples provide coverage of all applicable limit states whether or not a particular limit state controls the design of the member or connection.

In addition to the examples which demonstrate the use of the *Manual* tables, design examples are provided for connection designs beyond the scope of the tables in the Manual. These design examples are intended to demonstrate an approach to the design, and are not intended to suggest that the approach presented is the only approach. The committee responsible for the development of these design examples recognizes that designers have alternate approaches that work best for them and their projects. Design approaches that differ from those presented in these examples are considered viable as long as the *Specification*, sound engineering, and project specific requirements are satisfied.

149

SUMMARY

Delegation of Connection Design

- Clearly indicate if the fabricator's engineer is expected to design connections. If so, clearly note the following:
  - Are design calculations required to be signed and sealed,
  - Are shop drawings required to be signed and sealed, and
  - Clearly identify which connection details are in the fabricator's scope, and which are not.
  - For connections that are not in the fabricator's scope, ask yourself this:
    - Can this connection, as shown, be 100% completely detailed with the information provided?

150

SUMMARY

Connection Design Criteria

- Clearly indicate which code, specifications(s), and standard(s) are to be used for connection design.
  - Identify which edition is in affect; avoid specifying "the latest edition."
  - Be consistent throughout the design documents.
  - Identify the design methodology to be used, ASD or LRFD; be consistent throughout the design documents.
  - If different specifications are to be used for gravity and lateral systems, clearly note the requirements for each.
    - If so, clearly identify on the design drawings the members that a part of the lateral system(s).

151

SUMMARY

Connection Design Criteria

- If certain connection types are not permitted, clearly note which types are excluded.
- If "seismic strength or detailing" is required for progressive collapse considerations, note this in the design documents.
- Clearly identify which connections are to be bearing-type, snug-tight, pretensioned, slip-critical, etc.
  - For slip-critical connections, note Class of connection. If working with the 13^{th} ED. Note if connection is to be designed at the strength or service level.

152

SUMMARY

Connection Design Loads

- Provide actual beam shear demands wherever possible.
  - UDL loads are usually unnecessarily expensive, can be unsafe in some cases, and are harmful to the steel industry in the long run.
- Where horizontal shears are present, provide the load and identify the point of application (T/member, B/member, gravity axis, etc..)
- Provide actual moment demands for rigid connections. Avoid member strength design whenever possible.
  - Provide enough information so that beam connection design, continuity plates/stiffeners, panel zones can be accurately evaluated.

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SUMMARY

Connection Design Loads (cont.)

  - Note whether or not the effect of panel zone deformations on frame stability was considered.
  - However, recall that the COSP requires the EOR to identify where continuity plates and doubler plates are required.
    - Note that simply stating the plates are required is not sufficient; plate thickness and weld requirements must be provided.
- Clearly identify the magnitudes and locations of transfer forces.
  - If transfer forces must be evaluated by the fabricator's engineer, clearly outline the method to be used to make this evaluation.

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SUMMARY

Stiffener Plates

- Clearly identify where stiffener plates/continuity plates are required for force transfer, web or flange stiffening, etc...
  - However, recall that the COSP requires the EOR to identify where stiffener plates are required.
    - Note that simply stating the plates are required is not sufficient; plate thickness and weld requirements must be provided.
  - If stiffener plate requirements must be evaluated by the fabricator's engineer, clearly note the loads to be considered.

155

SUMMARY

Welding Requirements

- Provide complete weld symbols on details not within the fabricator's scope.
  - Where fillet weld symbols are shown without the weld size, provide a not stating that these welds symbols indicate:
    - Minimum weld sizes per AISC 360, or
    - Provide the load for which the weld is to be sized.
- Make sure you are familiar with AWS's new CJP weld symbol.
- Where stiffener/continuity/web doubler plates are "mandated," the weld requirements for attaching the plates need also be provided.

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SUMMARY

Design/Submit/Review/Approve Process

- The SEoR review of design calculations and/or shop drawings is not a vehicle for RFI's.
- Design calculations must be complete and legible.
  - The connection designer should provide FBD's for connections where there are multiple admissible load distributions, and limit state demands are not readily apparent to the reviewer.
- Connection designers should provide some sort of map that links a particular calculation/drawing to the location in the structure.

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SUMMARY

Design/Submit/Review/Approve Process (cont.)

- Submittals should be on time as required by the agreed upon submission schedule; reviews should be done in a timely manner.
- SEoR's should keep an open mind when reviewing atypical connections.

Teamwork

- When SEoR's designate the fabricator's engineer to design connections, a design team is in place.
  - Respect each other's expertise and suggestions.

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Effective Communication of Connection Design

QUESTIONS

or

Comments

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